The Speedcycle: a design-led framework for fast and slow circular fashion lifecycles

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Abstract: This paper reviews a project within the multi-disciplinary Mistra Future Fashion research programme (2015-2019) which aims to provide guidelines for designers to better design circular fashion products for 'appropriate speeds'. Researchers at UAL have been exploring the seemingly opposed approaches to fast and slow 'fashion speeds' through a literature and practice review, alongside workshops with industry and emerging designers to better understand the challenges for designers. In this paper the author reviews key insights from initial design workshops and proposes a framework 'The Speedcycle' as way to represent multiple rhythms and speeds within a product's entire lifecycle – a graphic model that visually demonstrates that notions of 'speed' are relevant across all stages of the lifecycle. The intention is to develop the discourse from simply fast and slow, to a level where multiple and proportionate speeds can be understood and ultimately engineered, to improve the circular efficiency of a product.

Keywords: lifecycle thinking, design tools, circular fashion, speeds of use, systems design.

1 Introduction 1,000w

'Designing for Circularity' has become a common goal across both academia and industry in recent years. The challenge to create products which are truly circular within the fashion and textile value chain seems a logical step towards the better use and retention of our valuable material resources. However, the abstract or 2-dimensional concept of a closed-loop only becomes useful if applied to a real context and in the case of fashion products that context is broad and complex. In this project we are seeking to view fashion speeds in a detailed analysis from a neutral standpoint in order to ask whether 'slowing down the system' is the only way to create a less impactful industry for the future? Or whether in fact we need an 'ecology of speeds' as is prevalent in nature in order to best serve the environmental challenges we face. 'We're caught between two economies of time…One Fast and Furious, the other slow. Industry need not design what it makes to be durable beyond a certain amount of time, any more than nature does' (Kendall, 2014).

1.1 Material v Product Longevity towards Circular Design

In Mistra Future Fashion Phase 1 (2011-2015) design-researchers explored ways to improve the sustainability credentials of fashion products through a series of design-artefacts which responded to a pre-established set of strategic approaches to sustainability (The TEN). During this process it became clear that although most outcomes shared a common approach of 'lifecycle thinking' in their conception, there was another dimension to the prototypes which had not previously been built into this lifecycle approach – speed (or length of designed lifetime). In analysing the resulting proposals there was an emerging 'polarity' of approaches. Although all concepts shared the common goal of reducing impacts across the lifecycle, some of the designs pointed towards a 'slowing down' of the fashion product (through extended life techniques, upcycling and repair for example) whilst others were very different in approach.

These concepts pointed towards a potential 'speeding up' of the fashion product through the use of lean, clean production technologies with a smooth connection through the end of life phase back into a high quality new material (designing for closed loop systems). Another way to express the different approaches is to imagine the focus ranging from 'material longevity' (enabling repeated use of material resources through efficient recycling) to 'product longevity (extending the useful lifetime of products through physical and emotional durability approaches (Chapman, 2008) and upcycling) see Fig 1. Both of these approaches seemed plausible in their context and ambition and so began the subject for exploration during Phase 2 (2015-2019), 'To explore and evaluate the environmental potential of the design and user potential of short-life vs. long-life garments for a sustainable circular economy'.

Figure 1. Research artefacts from Mistra Future Fashion Phase 1 (2011-2015), University of the Arts London. [*www.textiletoolbox.com*](http://www.textiletoolbox.com)

Concept	Circular Approach	Material v Product Longevity
Seamsdress: Vertical laser production for monomaterial garments increases recyclability at end-of-life stage	designing for ease of material recycling	Material Longevity
Denature: Coded materials generate unified identification for enhanced recyclability in a closed-loop chemical recycling system	designing for ease of material recycling	Material Longevity
A.S.A.P.: Short-life, carbon-low materials for fast recovery and repurposing for appropriate user behaviour in a high volume fashion context	designing for ease of material recycling	Material Longevity
Sweaver: Discarded Swedish fashion becomes high-end upholstery and accessories when crafted by a network of cabin weavers	upcycling for extended material use (by craft industry)	Product Longevity
Fast ReFashion: Designers who provide democratic upcycling design services for users, employ online and domestic tools	designing for emotional attachment (through co-design)	Product Longevity
Smorgas Board: Designers who provide playful tactile tools for users, empowering them with democratic digital design approaches and emotionally durable products	designing for emotional attachment (through co-design)	Product Longevity
Inner / Outer: The transition of design practice as 'social entrepreneur' connecting innerand outer change through making	designing for emotional attachment (through mindfulness)	Product Longevity
Shanghai Shirts: Aesthetics and symbolism, combined with upcycled garments, encourage better consumption decisions made by users	upcycling for extended use (by user)	Product Longevity
ReDressing Activism: Upcycling and activist approaches inspire, educate and support emerging fashion textile entrepreneurs	upcycling for extended material use (by user)	Product Longevity
Library Jumper: Designers employ collaborative consumption and collective repair approaches	designing for extended use (through user repair)	Product Longevity

Table 1. Summary Review of Phase 1 Design Research Artefacts which can be viewed at www.textiletoolbox.com

This insight (that longevity can be considered from either a materials or product perspective) reveals an opportunity for broadening our current understanding of how to design environmentally sound fashion products which acknowledges the complexity and variation present in the current fashion system. This idea of 'fashion rhythms' of different garment archetypes was first explored by Fletcher & Tham, in their 2004 project 'Lifetimes' (http://lifetimes.info/). It clearly revealed how the fashion landscape could be divided from short-life to long-life products, and how we develop very personal relationships with these different products which relates directly to length of use and time to disposal. We now need to bring this understanding into the design process, to address a gap in knowledge relating to the understanding of garment rhythms in the context of circular design, the ultimate goal being preservation of material resources in the system.

Through our review of academic literature and industry responses we found an overwhelming majority of sustainability approaches in design relate to making products of higher quality which last longer. There are obvious gains with this approach and a recent report by Wrap, UK (2015) states that 'extending the life of clothing by an extra nine months of active use would reduce carbon, waste and water footprints by around 20-30% each'. The problem with focussing only on product longevity is that you may end up with a 'durable' material (such as recycled polyester) being used in a short-life product (fashion top) with no means of recollecting or recycling it at end of life. This high impact non-renewable resource (polyester) has already been recycled once, which is to be commended, however if that reuse creates only a few weeks of extra usefulness (with perhaps only 5-6 uses) then the material which has taken millions of years to form in the earth, and more valuable resources to transform will very quickly become discarded and take a further 200 years minimum to degrade, whilst leaching contaminants back into the soil as it does so. The intention, whilst not wrong, is lost very quickly in the real world use and action of the user. By reducing our focus to only a 'part' of the system (the use phase) we are playing into the hands of 'unintended consequence' and often simply shifting impacts further along the product lifecycle, albeit out of view.

We need to find ways to understand the potential impacts of each and every design decision we make, and the specific attributes of the products we are designing in relation to their life-journey. We must stop viewing the product as the ultimate vehicle for longevity and start to see the materials themselves as holding the true value. With this shifted perspective we can break the cycle of only seeing materials and products in human-centred timeframes, believing a product which lasts 5 years solves all our problems when the materials in that product will last potentially hundreds of years if designed to do so. Not as a single product but as an ecology of material flows which retain material value in multiple product-lifetimes.

2 Circular Speeds: A Lifecycle Framework

The interpretation of 'speed' in the fashion industry often relates to the 'use phase' of a product (Fletcher & Tham 2004); designed obsolescence versus designed longevity and reuse. It is also used to describe 'production speed'; how quickly a product can be delivered from concept to store. This understanding was also evident in multiple workshops during 2015/2016 where we tested concepts of fast and slow with industry and academic participants (see Fig 2.) In these interpretations the usual conclusion is that only 'longevity' and a 'slowing down' of the fashion system could ever reap environmental benefits. However, 'the literature clearly documents the tensions and complexities of designing for longevity……designers play a significant role in these scenarios and yet little is known about how viable these practices are in practice' (Connor-Crabb et al 2016). In order to shed light on what these practices may be in relation to designing for longevity (be it of product or material retention) the author proposes another way of viewing and understanding the speed of fashion products by relating it to the stages of a product lifecycle. In order to design effective 'circular' products for fashion we must understand speeds in all lifecycle contexts; materials, production, use and recovery. If we intend a product to be retained, returned and recycled efficiently we need to be able to understand it's journey back into the materials loop.

Figure 2: Workshops with emerging designers, industry and academic collaborators from UAL, during 2015 and 2016 exploring Fast and Slow concepts.

2.1 Notions of Speed in Relation to Lifecycle

In order to articulate a view of speed as it relates to each stage of the lifecycle the author developed the spectrum in Fig 3. as a tool for provocation and discussion with research partners and stakeholders. For this purpose the cycle was divided into four categories; raw materials, production, use and recovery. Each is discussed in relation to speed and longevity. Initial insights are discussed below and will form the basis of further research during 2017.

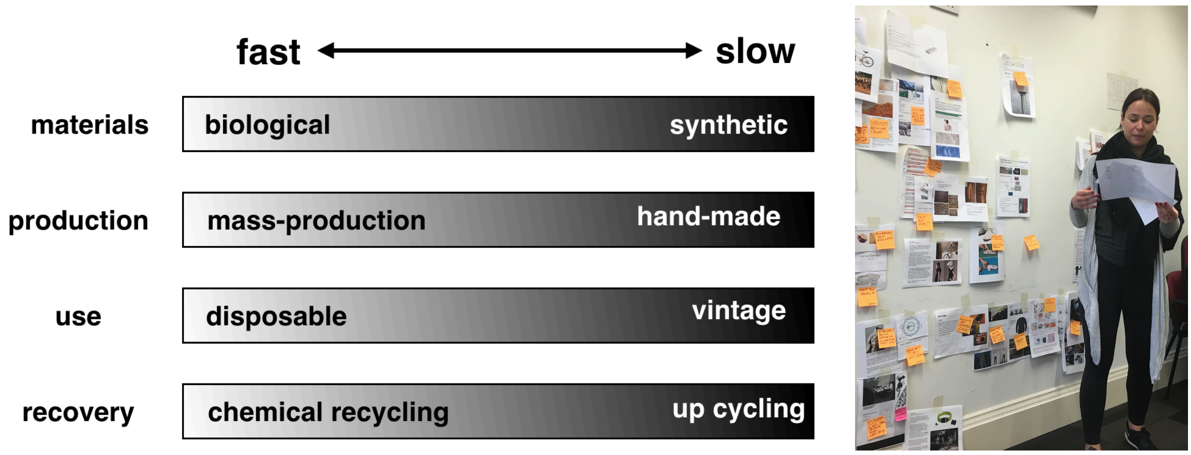


Figure 3: Exploring Fast & Slow concepts through a lifecycle framework, UAL, 2016.

2.2 Raw Material Speeds (Embodied Energy of Resources)

One of the key aspects of a product's lifecycle is its raw material source. 'Natural' fibres, based in agriculture are 'renewable' resources, that is to say they can be grown over and again from the same resources. They just need water and sunlight (and often a dose of chemicals) and they can keep providing material resources. The time taken to 'grow' the materials is short (fast) and therefore they could be considered to have a 'low embodied energy' and low impact – could they be considered fast materials? However, materials such as polyester are made from oil which takes millions of years to form and therefore are considered 'non-renewable' (certainly in our lifetime) and therefore could be described as 'slow'. This is perhaps anti-intuitive when 'slow fashion' so often relates to natural rather than synthetic materials, but it is a prime example of how the way we have learned to associate certain materials as fast or slow is sometimes misleading. We can also make 'regenerated' materials from 'natural resources. Should we consider these fast or slow? In this context 'fast' is considered 'better' than slow, but in a holistic systems approach we can only make that judgement call after assessing the entire lifecycle; perhaps a high impact material cancels out impacts in other areas of the cycle?

2.3 Production Speeds (Impacts of Manufacture)

In terms of production the spectrum from fast to slow could be compared to that of 'hand production' (slow) through to automated 'mass' or 'digital' production (fast). How do we consider which is preferable here? Are the impacts of production less per garment if you were to consider a holistic LCA (lighting and heating a room with only one person in it) versus the economies of scale in mass-production? Is it feasible to expect all manufacture to be slower? Is it necessary for all products to be of the highest quality? These questions again relate so heavily to the specific context of the product. Are impacts of industrial production only perceived as greater because they relate to a mass-industry? If production methods are out of balance with the expected lifetime of a product (high impact production in a short-life non-renewable material) then we have a mismatch.

2.4 Fashion Speeds (Durability of Style)

The need for fashion to be constantly evolving, making us want more and more is embedded in our economic system, and 'designed obsolescence' is seen as contributing to the hugely consumerist position we find ourselves in today. A product can be seen to be 'fast' if it goes quickly out of style or is discarded due to low quality materials and construction (bad design decisions?). But is it actually the mismatch between the physical durability of the product (materials and construction) and the emotional durability of the product (ongoing desirability) that is the problem? In order to avoid an 'inappropriate marriage of excessive material durability with fleeting product lifespans.' (Chapman, 2008) we must stop isolating parts of the system during the design process. It would no more make sense for a high-fashion / short-life product to be made to last eternally than to make a potentially long-life 'classic' from such low quality materials that it falls apart before it is no longer desired. If material-quality is part of the aesthetic of 'desire' even in a 'fast' product - how do we reconcile that material value at the end of its short life?

2.5 Recovery Speeds (Ease of Material Regeneration)

Lastly what about the end of life story? Something not often discussed in terms of speed, and still very difficult to analyse through existing metrics (much of the technology here is so new we are not yet able to quantify the impacts conclusively). the 'ease of recovery' at end of life can range from a complete block through to efficient and economically viable techniques for regeneration back to virgin quality fibre. If a 'fast-use' product can be designed in such a way as to enable this smooth transition between subsequent 'product lives' then it is possible that material benefits may be similar to a scenario where a single product lifetime is extended. The recent Mistra Future Fashion Report 'Critical Aspects in Design for fibre-to-fibre recycling of textiles' (2016) outlines the multiple current barriers to full fibre-to-fibre recovery of valuable textile resources. Many of these barriers could be 'designed out' at the product concept stage if considered as part of the design brief.

3 Design Scenarios: exploring LCA variations

Lifecycle representations rarely communicate any proportionality in speed or timeframes. When trying to design within a specific context this becomes problematic and misses vital elements for consideration. If represented in models which do try to communicate a different set of journeys relating to speed you can immediately see the tensions which shift which each story. 'Speed' can be translated in very different ways if related to different parts of the life-cycle and often a product can therefore have multiple and often counter-intuitive mixes of speeds within a single product.

Building on previous practice-based research, reviewing the ground-breaking work emerging from the Mistra Future Fashion programme relating to 'design for fibre-to-fibre recyling' (Flander & Ljungkvist 2016) and LCA analysis (Roos et al, 2015), the author has compared and contrasted two intentionally polarised scenarios which 1) extend the use phase of a fashion product and 2) reduce it towards a hyper-short-life. By exploring these seemingly opposed approaches to viewing 'speed of use', the author proposes *The Speedcycle* as way to represent multiple rhythms and speeds within a product's lifecycle – a graphic model that visually demonstrates that notions of 'speed' are relevant across all stages of the lifecycle. The intention is to develop the discourse on from simply *fast* and *slow*, to a level where multiple and proportionate speeds can be both understood and ultimately engineered, to improve the *circular efficiency* of a product.

For the purposes of this exploration we have selected one example from the Phase 1 LCA research as a base comparison. Following this research we intend to run this process through with other examples and archetypes and an expanded set of design scenarios in cooperation with the industry and science partners on the project. In the following scenarios we refer to CPU (Cost per Use) which is an imaginary unit of 'impact'. It serves as a baseline in order to demonstrate comparisons between scenarios and bears no relation to any actual impact metrics (although these metrics will be considered in the next phase).

3.1 Speedcycle 1: Super Long Life (extending the use phase)

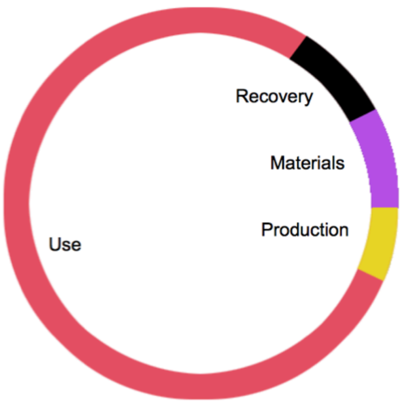
If we think of a garment which is designed to have a long life (relatively speaking) then you could say that it's environmental cost per wear comes down in relation to that extended use phase (see Fig 4.) Impacts during use (mainly laundry) become larger as a proportion of all impacts associated with that lifetime, whilst impacts associated with production and materials become smaller (as a proportion of the whole).

Extending the use phase and designing in (or adding further) product longevity is a common goal for many in improving the sustainability of a fashion product. Indeed it brings down the environmental impacts per wear as a proportion of the total impacts across the lifecycle (with each wear the other lifecycle impacts further reduce and divide). However, it may also add extra impacts ones through care and laundry, especially if the physical durability has been achieved through coatings or material features which render it suitable only for dry cleaning for example.

Perhaps a product is physically durable and equally emotionally treasured but not often worn? Therefore not impacting on a user's garment use profile over time and simply sitting redundant in their wardrobe. This surely has no conceivable benefit in reducing impacts over time? *…the longevity of a garment is influenced by a complex interplay between the material objects themselves, cultural norms and individual behaviour.* (Connor-Crabb 2016:23)

- If a product-life is doubled or even made ten times longer but at the cost of future recovery then it may be a false benefit? This raises many questions which need to be explored in order for design to adopt appropriate practices;
- If extending life can be said to bring down the environmental 'cost per wear' and is therefore desirable, how can we build in not only 'physical duarbility' features but also encourage a longer relationship with the user (emotional durability).
- If laundry impacts become more prominent in a long life product how can we set about reducing those impacts to further improve the 'cost per wear'?
- How can we balance 'physical durability' and end of life 'recyclability?

NARRATIVE 1: EXTENDING THE USE PHASE



Imagine a white cotton T-shirt…..we wear it 10 times before throwing it away and its baseline environmental ***'cost per use' is 10***

- *we can make it last longer (double) by increasing the physical durability of the material - if we can do that without any extra environmental impact (unlikely) -* ***CPU goes down to 5***
- *if we have to use extra materials or more energy intensive processes then it's CPU might stay the same or even go up) -* ***CPU remains 10 or higher***
- *if we make it physically more durable but in doing so don't manage to extend the 'emotional durability' or style-longevity' of the garment then that may also have a detrimental effect -* ***CPU remains 10 or higher***
- *if we make it physically more durable but in doing so change the material functionality to make it worn less often for any reason (i.e. because it's warmer or less comfortable or less smart) then -* ***CPU remains 10 or higher***
- *if we make it physically more durable but in doing so increase the laundry impacts (i.e. dry clean only? in need of more frequent washing per wear) -* ***CPU remains 10 or higher***
- *if we make it physically more durable but in doing so reduce its ability to be recycled effectively then although it's CPU may reduce down to 5 the material resources would become eternally wasted -* ***how do we account for that?***

Figure 4: Speedcycle Example 1: extending the use phase. Scenarios and Cost Per Use (CPU) calculations.

3.2 Speedcycle 2: Ultra Fast Forward (reducing the use phase)

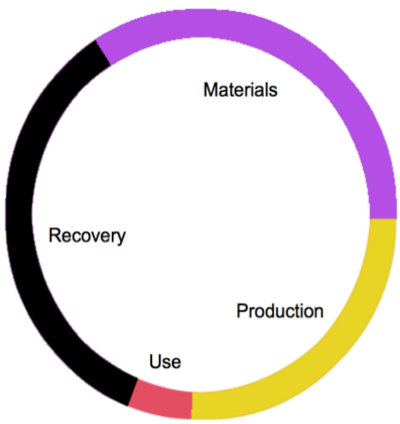
Reducing the use phase places more emphasis on materials recovery and end of life impacts – the 'cost per wear' is presumed to be very high. But simply trying to extend the life of a fundamentally 'fast' product will not work. Fast and slow models as they stand are opposing and incompatible.

In order to improve the environmental 'cost per wear' of a short-life product we could instead make the material and production impacts 'lighter' (by using renewable energy or less materials). This could result in a garment with exactly the same impact per use as a long life or higher impact one. As Cooper (2013) suggests 'while the reduction of a product's environmental footprint is important, it may not mitigate high levels of consumption and disposal. In terms of impacts of use, these will be much reduced or even completely eradicated in a short-life product.

Questions here include:

- Can we build the notion on speed into the whole cycle to ease the flow, including super-efficient materials recovery?
- If a material is fully recyclable (or easily compostable) then the end-of-life impacts replace those of raw material production completely in the following garment incarnation. (In this scenario it is conceivable that 100 short life impacts could equal 10 longer life ones.)
- Could this be reinterpreted to be a positive attribute for forward fashion? If production and recovery are perfectly matched and enabled then perhaps the best solution for some garment archetypes could even be disposability? Hard to imagine but not impossible.
- If short-life products are designed for a particular end-of-life scenario, how can we mobilise industry and the user to make sure the garment reaches the right place to make sure that is the end destination?
- If laundry impacts are removed, how can we build in a reasonable durability to prevent the complete 'disposability' of the product? Tech challenges here for materials.
- How can we communicate to the consumer the intention of this product lifespan?

NARRATIVE 2: REDUCING THE USE PHASE



*Imagine that same white cotton T-shirt…we wear it 10 times before throwing it away and its environmental **'cost per use' is 10***

** if we accept that as a seasonal fashion item it will only be worn 5 times before becoming unwanted and disposed of then how can we keep the **CPU at 10 or higher**?*

- *we could reduce the impacts during materials extraction or production stages by half*
- *we could reduce make it zero launder thus further cutting the impacts per wear*
- *if we could recycle the materials at end of life with fewer impacts than using virgin materials then we could produce subsequent garments at a much lower CPU*

Figure 5: Speedcycle Example 1: reducing the use phase. Scenarios and Cost Per Use (CPU) calculations.

4 Key Insights

Circular Design can be both Fast and Slow (longevity can relate to both material and product retention).

We need to tackle emotional longevity and issues of planned obsolescence (fashion) alongside physical durability.

There are tensions and trade-offs between designing for material v product longevity. In creating durable product we may also be preventing material recovery at a later date.

Designers need positive examples of fast fashion as a circular model. At present they are difficult to find and much needed for a realistic approach to the industry. Slow seems to reject industry and fast seems to reject sustainability values. We need to present both in new terms.

How we think about 'time' in our design process is crucial. LCA studies in Mistra Future Fashion have calculated 'impact per wear'. In other words it doesn't matter if a garment is used ten times in one year or ten times in five years. It's the 'number' of uses before end of life that's important in environmental terms. We need ways of understanding the implications of this at the design stage. Are there differences between a garment designed for ten uses in a short period of time as compared to one which might be kept over a longer period of time?

Is there an optimum 'impact score' we are aiming for? If so can we achieve the same cost per wear by reducing production costs rather than extending life with more impactful materials? I would argue they could both have the same end result.

Product archetypes and rhythms of use – designers, consumers & retailers. (distinction in retail: between fashion basics: jeans/t shirts = slower change of styles but higher volume sales & seasonal high fashion = fastest turnaround & greatest profit.) role of the outdoor apparel bands & health/fitness in slow-fast continuum = a fast fashion culture incorporating a non-fashion ethos, ethical practices & longevity.

5. Conclusion (further work)

In Mistra Future Fashion Phase 2 we are working collaboratively across the disciplines of materials science (recycling & production technologies), social science (user behaviour) and industry engagement (workshops with design teams) in order to understand how a more holistic circular approach might be useful for design.

Each of these disciplines is connected primarily to a part of the lifecycle and by working together we hope for a collective understanding of the 'whole'. This is done through an intentionally polarised set of examples, which explore short-life and long-life garment scenarios. Alongside the theoretical discussion there is a sub-narrative element which follows the logic through a specific garment archetype – the cotton t-shirt, the polyester dress, the outdoor jacket, the denim jean - and refers to existing Mistra Future Fashion Phase 1 research in setting out a 'direction of travel' in terms of environmental 'costs per use' in order to seek insight and guidelines for design (the focus of the Mistra Future Fashion Phase 2 programme). This paper does not offer new scientific research or metrics, rather it attempts to translate existing research into a framework for understanding how to design appropriately for product speeds. The next step is to combine the inputs of designers from industry with scientists insights (LCA) from the consortium to try to find a common language with which to move forward.

References

Chapman, J. (2008) Emotionally Durable Design: Sustaining relationships between users and domestic electronic products, http://eprints.brighton.ac.uk/6641/1/485756_Redacted.pdf

Kendall, S., (2014) Design Time, Or Wabi Sabi And The Long Now, blog post, http://stuartkendall.com/?p=171

Connor-Crabb, A., Miller, K. and Chapman, J. (2016) Design Strategies for the Eternal Reoccurrence of the New, Fashion Practice, 8:1, 22-43 <http://dx.doi.org/10.1080/17569370.2016.1147806>

Cooper, T Ed. (2010) 'Longer Lasting Products: alternatives to the throwaway society', Gower Publishing, UK

Earley et al, (2014) Textile Toolbox Exhibition, http://www.textiletoolbox.com/

Elander, M. and Ljungkvist, H. (2016) Critical Aspects in Design for fiber-to-fiber recycling of textiles, Mistra Future Fashion, Stockholm

Tham, M. & Fletcher, K., (2004) Clothing Rhythms. In: E. Hinte, ed. Eternally Yours: Time in Design. 010 Publishers, pp. 254-274.

Tham, M. & Fletcher, K., (2004) Lifetimes, AHRC Funded Project http://lifetimes.info/

H&M Circular Lab Launch, available at https://www.youtube.com/watch?v=XNLK6ceKrpg <accessed 02.08.2016>

Mistra Future Fashion Programme (2011-2019) http://mistrafuturefashion.com/

Mugadza, Grace. (2015). Systems Thinking and Design Thinking: Complimentary Approaches?. Systems Thinking World Journal: Reflection in Action. [Online Journal]. 3. [Referred 2015-2-9]. Available: http://stwj.systemswiki.org . ISSN-L 2242-8577 ISSN 2242-8577 < http://stwj.systemswiki.org/?p=1723>

Roos, S., Sandin, G., Zamani, B., Peters, G. M. (2015). Environmental assessment of Swedish fashion consumption. Five garments—sustainable futures. Mistra Future Fashion, Stockholm, Sweden. http://mistrafuturefashion.com/wp-content/uploads/2015/06/Environmental-assessment-of-Swedish-fashion-consumption-LCA.pdf

TED, Textiles envrionment Design, (2012) The TEN http://www.tedresearch.net/teds-ten-aims/

WRAP, (2015) Valuing our Clothes: the true cost of how we design, use and dispose of clothing in the UK, http://www.wrap.org.uk/sites/files/wrap/VoC%20FINAL%20online%202012%2007%2011.pdf

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